NTSB National Transportation Safety Board

Data:

The Fuel for Improving Safety

Presentation to:

Data for ZIPP

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Date: May 1, 2013

Outline

- The NTSB
- The Process: Collaboration
- Data as Fuel for the Process
- Safety Benefits
- Productivity Benefits
- Successes and Failures
- Future Challenges

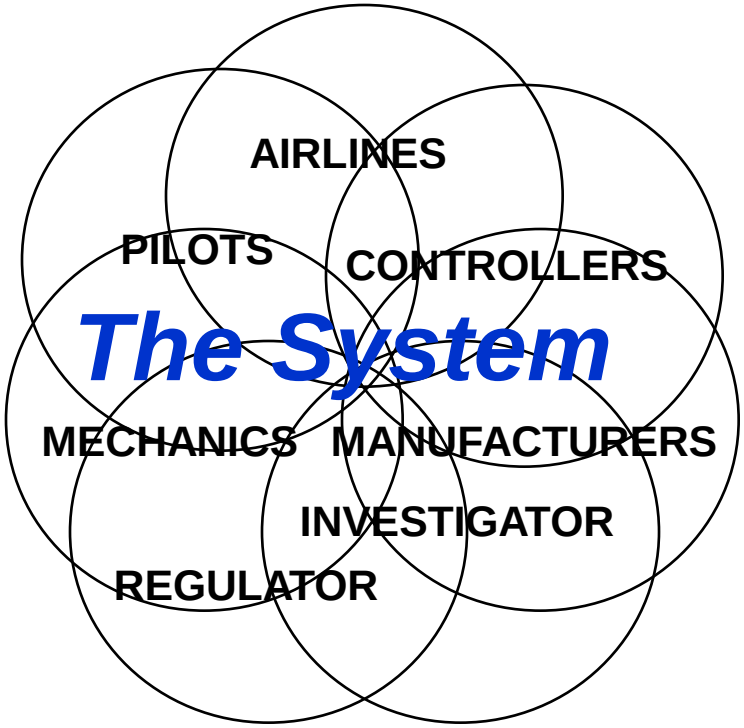
NTSB 101

- **Independent federal agency, investigate transportation accidents, all modes**
- **Determine probable cause(s) and make recommendations to prevent recurrences**
- **Determine *cause,* not *liability or blame***
- ***SINGLE FOCUS IS SAFETY***
- **Primary product: Safety recommendations**
  - **Acceptance rate > 80%**

The Context: Increasing Complexity

- **More System *Interdependencies***
  - – Large, complex, interactive system
  - – Often tightly coupled
  - – Hi-tech components
  - – Continuous innovation
  - – Ongoing evolution

- **Risk Management Issues Are More Likely to Involve *Interactions Between Parts of the System***



Effects of Increasing Complexity:

More "Human Error" Because

- System More Likely to be Error Prone
- Operators More Likely to Encounter Unanticipated Situations
- Operators More Likely to Encounter Situations in Which "By the Book" May Not Be Optimal ("workarounds")

The Result:

Front-Line Staff Who Are

- Highly Trained

- Competent

- Experienced,

-Trying to Do the Right Thing, and

- Proud of Doing It Well

. . . Yet They Still Commit

Inadvertent

Human Errors

The Solution: System Think

Understanding how a change in one subsystem of a complex system may affect other subsystems within that system

“System Think” via Collaboration

Bringing all parts of a complex system together to collaboratively

- **Identify potential issues**
- ***PRIORITIZE* the issues**
- **Develop solutions for the prioritized issues**
- **Evaluate whether the solutions are**
  - **Accomplishing the desired result, and**
  - **Not creating unintended consequences**

Major Paradigm Shift

How It Is Now . . .

You are highly trained

and

If you did as trained, you would not make mistakes

so

You weren't careful enough

so

You should be PUNISHED!

How It Should Be . . .

You are human

and

Humans make mistakes

so

Let's *also* explore why the system allowed, or failed to accommodate, your mistake

and

Let's IMPROVE THE SYSTEM!

Objectives:

Make the System

(a) Less Error Prone

and

(b) More Error Tolerant

The Health Care Industry

To Err Is Human:

Building a Safer Health System

"The focus must shift from blaming individuals for past errors to a focus on preventing future errors by designing safety into the system."

Institute of Medicine, Committee on Quality of Health Care in America, 1999

Major Source of Information: Hands-On "Front-Line" Employees

"We Knew About That Problem"

(and we knew it might hurt someone sooner or later)

From Data to Information

Tools and processes to convert large quantities of data into useful information

Data Sources

Info from front line staff and other sources

DATA

Analysts

Tools

Processes

USEFUL

INFORMATION

Smart Decisions

- **Identify issues**
- ***PRIORITIZE!!!***
- **Develop solutions**
- **Evaluate interventions**

Collaboration Success Story

65% Decrease **in Fatal Accident Rate, 1997 - 2007**

largely because of

System Think

fueled by

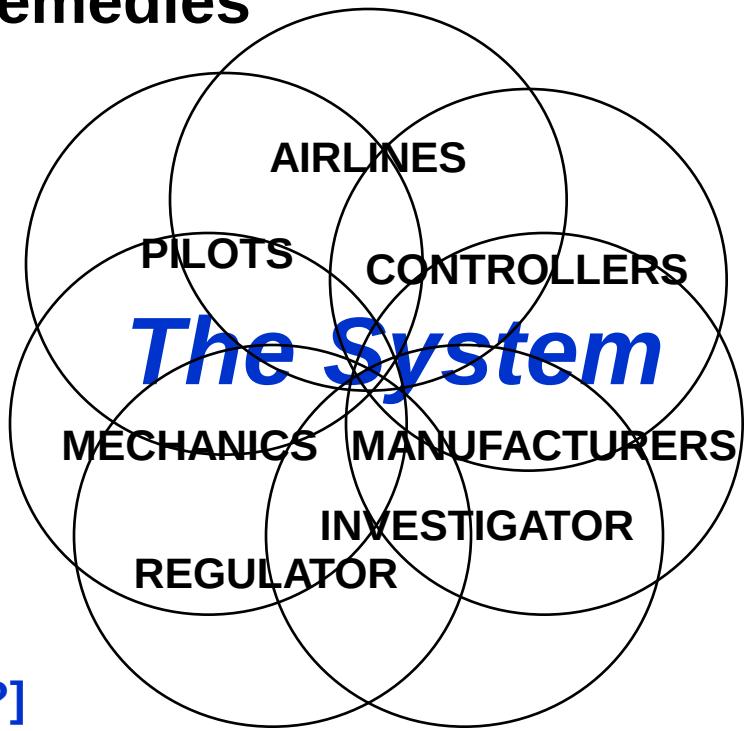
Proactive Safety Information Programs

P.S. Aviation was already considered *VERY SAFE* in 1997!!

Commercial Aviation Safety Team (CAST)

Engage *All* Participants In Identifying Problems and Developing and Evaluating Remedies

- Airlines
- Manufacturers
  - *With the systemwide effort*
  - *With their own end users*
- Air Traffic Organizations
- Labor
  - *Pilots*
  - *Mechanics*
  - *Air traffic controllers*
- Regulator(s) [Query: Investigator(s)?]



Contravene Conventional Wisdom??

- Conventional Wisdom:

Improvements that reduce risk usually *also reduce productivity*

- The Reality:

Risk reduction programs are usually a *NON-STARTER* if they hurt productivity

- Lesson Learned from the CAST process:

Risk can be reduced in a way that also results in *immediate productivity improvements*

Moral of the Story

Anyone who is

involved in the problem

should be

involved in the solution

Another Paradigm Shift

- **Old: The regulator identifies a problem, develops solutions**
  - **Industry skeptical of regulator's understanding of the problem**
  - **Industry fights regulator's solution and/or implements it begrudgingly**
- **New: Collaborative "System Think"**
  - **Industry involved in identifying problem**
  - **Industry "buy-in" re solution because everyone had input, everyone's interests considered**
  - **Prompt and willing implementation . . . *and tweaking***
  - **Solution probably more effective and efficient**
  - **Unintended consequences much less likely**
- ***Note: The CAST process generated no new regulations!***

Challenges of Collaboration

- **Human nature: "I'm doing great . . . *the problem is everyone else"***
- **Participants may have competing interests, e.g.,**
  - **Labor/management issues**
  - **May be potential co-defendants**
- **Regulator probably not welcome**
- **Not a democracy**
  - **Regulator must regulate**
- **Requires all to be willing, *in their enlightened self-interest,* to leave their "comfort zone" and think of the System**

Collaboration at Other Levels?

- **Entire Industry**
- **Company (Some or All)**
- **Type of Activity**
- **Facility**
- **Team**

Manufacturer Level "System Think"

Aircraft manufacturers are increasingly seeking input, from the earliest phases of the design process, from

- ***Pilots*** **(*User* Friendly)**
- ***Mechanics*** **(*Maintenance* Friendly)**
- ***Air Traffic Services*** **(*System* Friendly)**

Data Success Stories

- **Ground Proximity Warning System**
  - *S: Reduced warning system complacency*
  - *P: Reduced unnecessary missed approaches, saved workload, time, and fuel*

- **Flap Overspeed**
  - *S: No more potentially compromised airplanes*
  - *P: Significantly reduced need to take airplanes off line for VERY EXPENSIVE (!!) disassembly, inspection, repair, and reassembly*

Failure: Could Better Data Have Broken the Chain?

- **Strasbourg, France, 1992**
- **Risk Factors**
  - *Night, Mountainous Terrain*
  - *No Ground Radar*
  - *No Ground-Based Glideslope Guidance*
  - *No Airborne Terrain Alerting Equipment*
- **Very Sophisticated Autopilot**
- **Autopilot Mode Ambiguity**

Autopilot Mode Ambiguity

- **"3.2" in the window, *with a decimal*, means:**
  - **Descend at a *3.2 degree angle (about 700 fpm at 140 knots)***
- **"32" in the window, *without a decimal*, means:**
  - **Descend at *3200 fpm***
- **Clue: Quick Changes in Autopilot Mode Frequently Signal a Problem**
  - ***Flight data recorder readout program could have helped safety experts uncover this problem***

Another Failure:
Inadequate "System Think"

- **1995 – Cali, Colombia**
- **Risk Factors**
  - ***Night***
  - ***Airport in Deep Valley***
  - ***No Ground Radar***
  - ***Airborne Terrain Alerting***
    Limited to "Look-Down"
  - ***Last Minute Change in Approach***
    - ***More rapid descent (throttles idle, spoilers)***
    - ***Hurried reprogramming***
- **Navigation Radio Ambiguity**
- **Spoilers Do Not Retract With Power**

Recommended Remedies Include:

- **Operational**
  - ***Caution Re Last Minute Changes to the Approach***
- **Aircraft/Avionics**
  - **Enhanced Ground Proximity Warning System**
  - **Spoilers That Retract With Max Power**
  - **Require Confirmation of Non-Obvious Changes**
  - **Unused or Passed Waypoints Remain In View**
- **Infrastructure**
  - **Three-Letter Navigational Radio Identifiers**
  - **Ground-Based Radar**
  - **Improved Reporting of, and Acting Upon, Safety Issues**

Note: All but one of these eight remedies address system issues

Sample Future Challenge: Increasing Automation

- Increasing complexity reduces likelihood that operators will completely understand what the system is doing
- Increasing reliability reduces likelihood that operators will be trained to respond to every potential problem
- How can better data help?

Example: Air France Flight 447

- **The Conditions**
  - Cruise, autopilot engaged
  - Night, in clouds, turbulence, coffin corner
  - Pitot tubes blocked with ice
  - Autopilot, among other things, inoperative without airspeed information
  - Alpha protections disabled without airspeed
  - Pilots' responses inappropriate

- **Queries**
  - Pilot training re loss of airspeed information in cruise?
  - Pilot training re hand-flying at cruise altitude?

Thank You!!!

Questions?